

Z(ee)+Jets: plans & status for APS

→ Plan:

- (xsection x BR) for Z(ee) + 0,1,2 jets
- Statistics for higher jet multiplicities limited:

n_jets	0	1	2	3	4	5	6
inclusive	6,216	964	161	36	11	3	1

- Z(ee)+X xsection as a crosscheck
 - Almost done to 0th order
 - Started looking at Z(ee)+nJets (n≥1,2)

Dataset

- Moriond 04 dataset: 221 pb⁻¹ of delivered lumi (04/19/02 - 09/07/03 runrange: 151816 - 180956)
- **EM1TRK skim**:
 - EM: (|ID|=10 OR |ID|=11) AND (pT>8.0GeV)
 - TRK: pT>5.0GeV within $\Delta\phi=1$ of EM object
- ATHENA **v01-04-02** root tuple
- Good event selection:
 - Jet/MET v5.0 list of bad LBNs (no T42)
 - CAL, SMT, CFT based on runquality database
 - **Bad LBNs for lumi calculation**
- Checking for event duplication
- DiEM triggers:
 - 2EM_HI = CEM(2,10) L3(loose, 1, 20) for triggerlist ≤ v11 (<= run 178721)
 - E1_2L20 = CEM(1,11) L3(loose, 2, 20) for triggerlist v12 (>= run 178722)
- Luminosity:

	2EM_HI	E1_2L20	Sum
delivered	174pb-1	47pb-1	221pb-1
recorded	145pb-1	44pb-1	189pb-1
recorded w/o bad LBNs	127.91pb-1	42.39pb-1	170.3pb-1
reco'd w/o bad LBNs	127.63pb-1	42.38pb-1	170.01pb-1



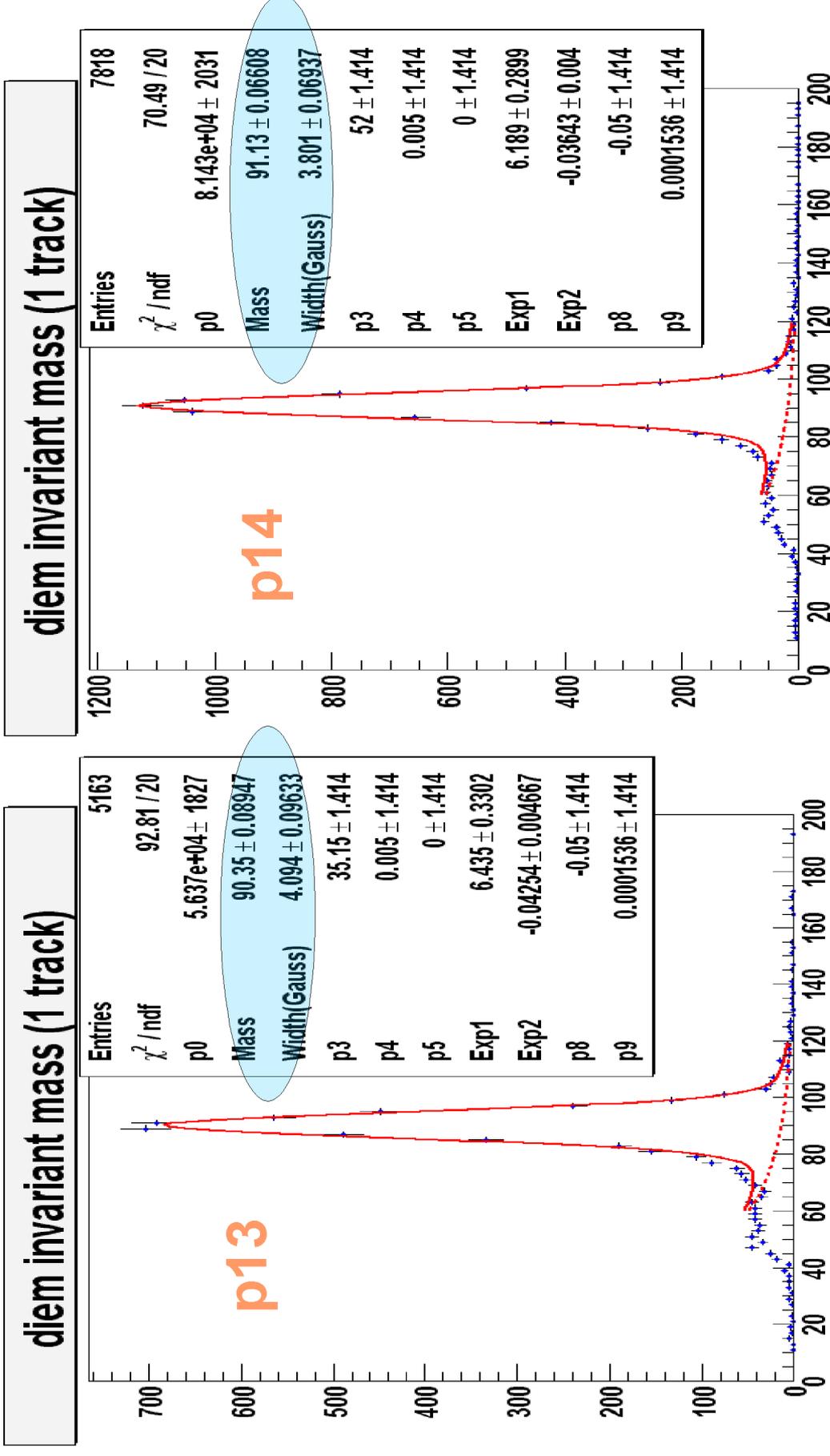
Bookkeeping information

- 520 million events to tape
- 32 million in EM1 TRK skim
- 3.944.345 events in ATHENA root tuple format
- **Duplicate events = 263.508**
- Events selected for analysis = 567.785
- Events with Z candidates = 6.216
- Z candidate events with dijets (inclusive) = 161

Electron and Jet selection

- **Electron selection:**
- $EMF > .9$
- $Iso < .15$
- $HM \times 7 < 12.$
- $pT > 20 \text{ GeV}$
- Including phi cracks
- CC-CC: $|\eta| < 1.1$
- Cut on χ^2 of track match based on E/p & distance
- $80 \text{ GeV} < M_{ee} < 100 \text{ GeV}$
- **Jet selection:**
- $.05 < EMF < .95$
- $Chfrac < .4$
- $HotFrac < 10.$
- $N90 > 1$
- L1 confirmation
- $pT > 20 \text{ GeV}$
- **d0correct removes all jets overlapping with any EM object within $dR = .4$**

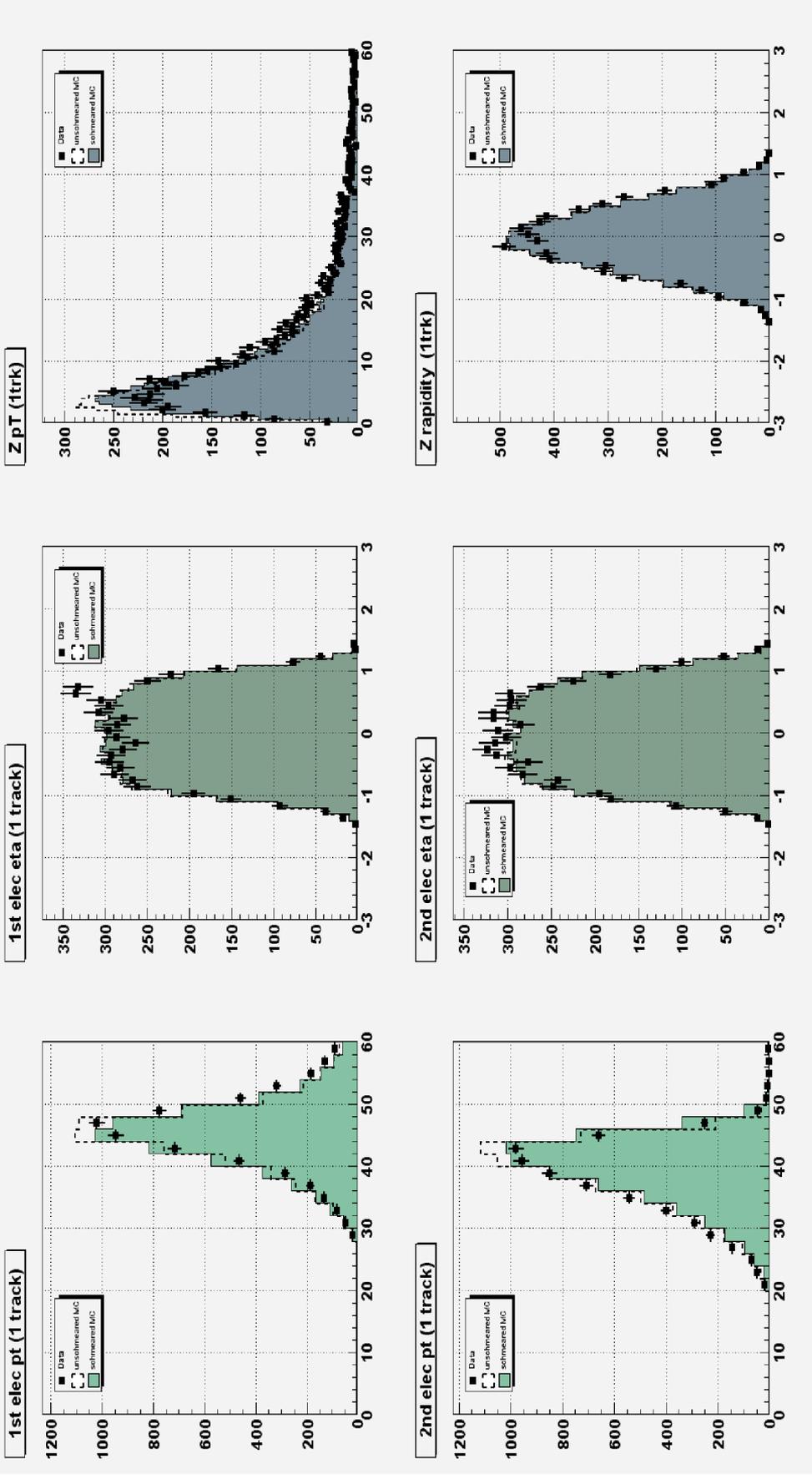
Z peaks (p13 vs p14)



Electrons in Z candidate events (p14 data vs PYTHIA MC)

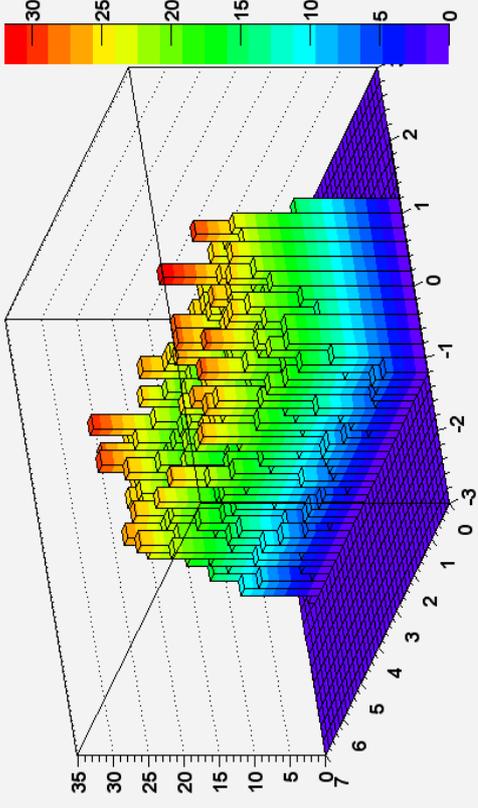
Electron smearing based on: $E' = E * \text{scale} (1 + \text{rndm.Gaus}(0, \text{smear}))$

with: scale=1.003 and smear=4.3%

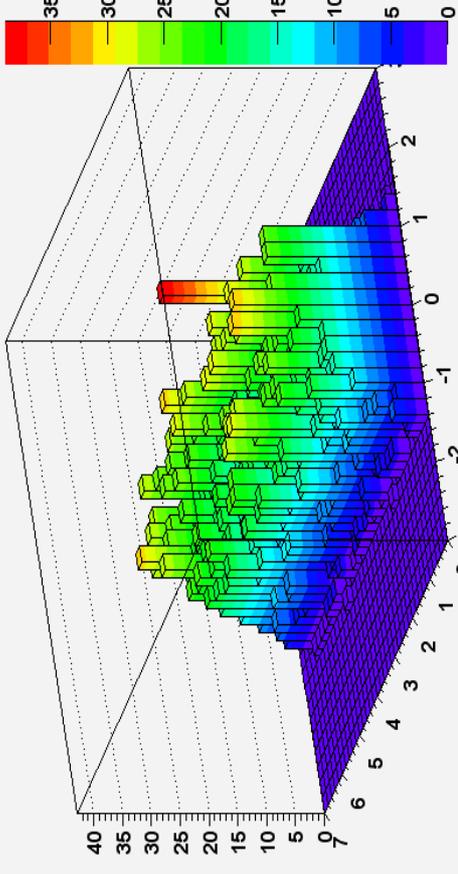


Electrons in Z candidate events (η vs ϕ)

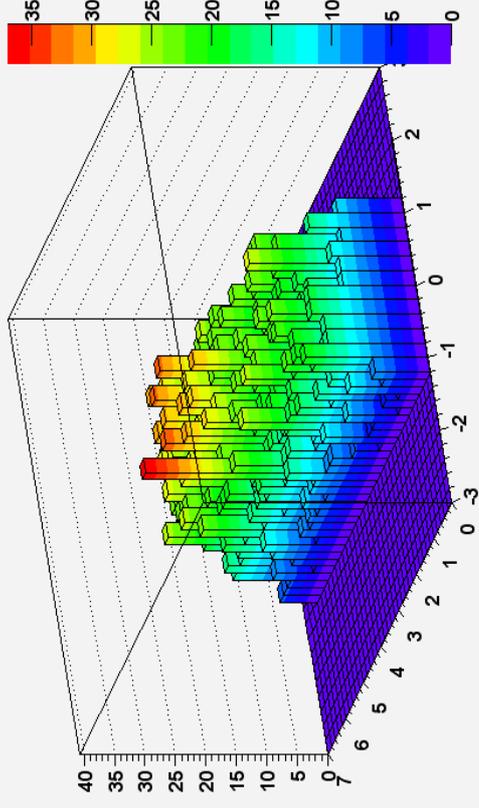
1st elec deteta vs detphi



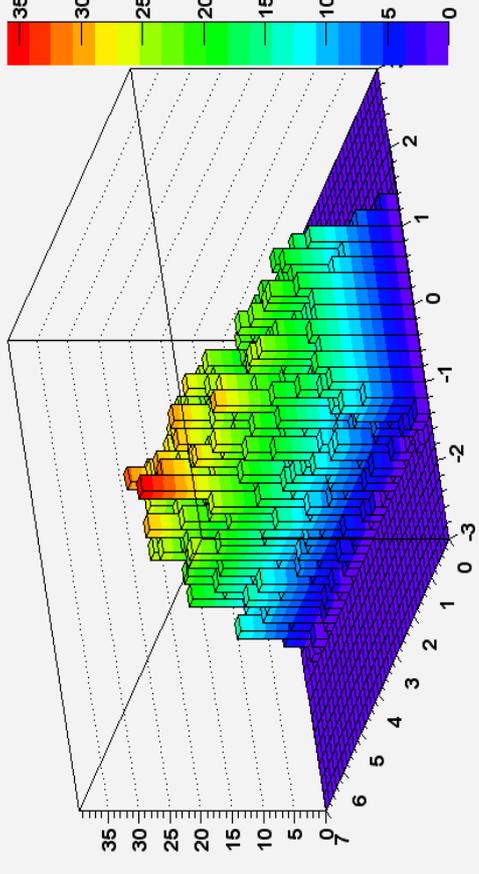
1st elec phyeta vs phyphi



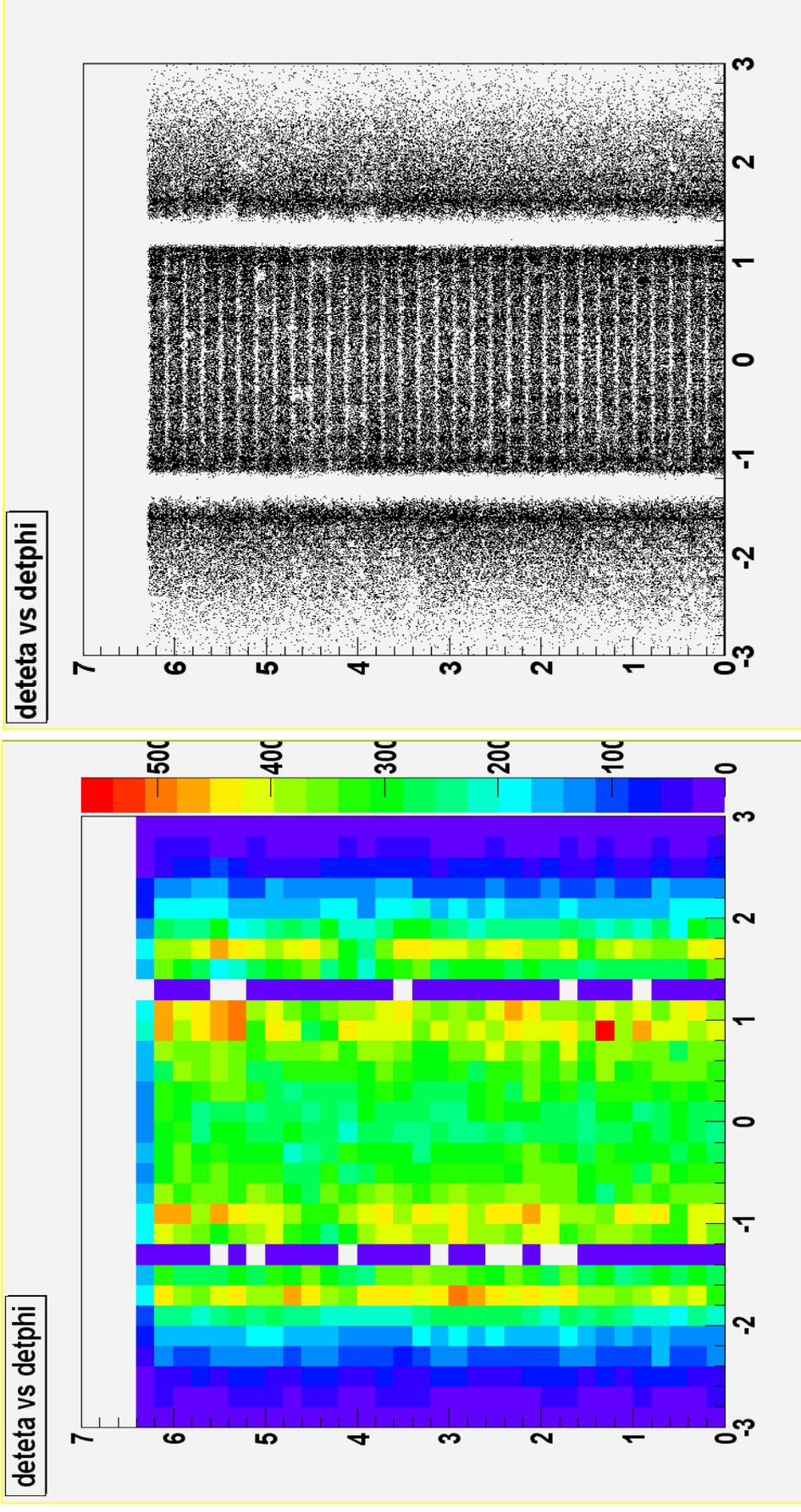
2nd elec deteta vs detphi



2nd elec phyeta vs phyphi



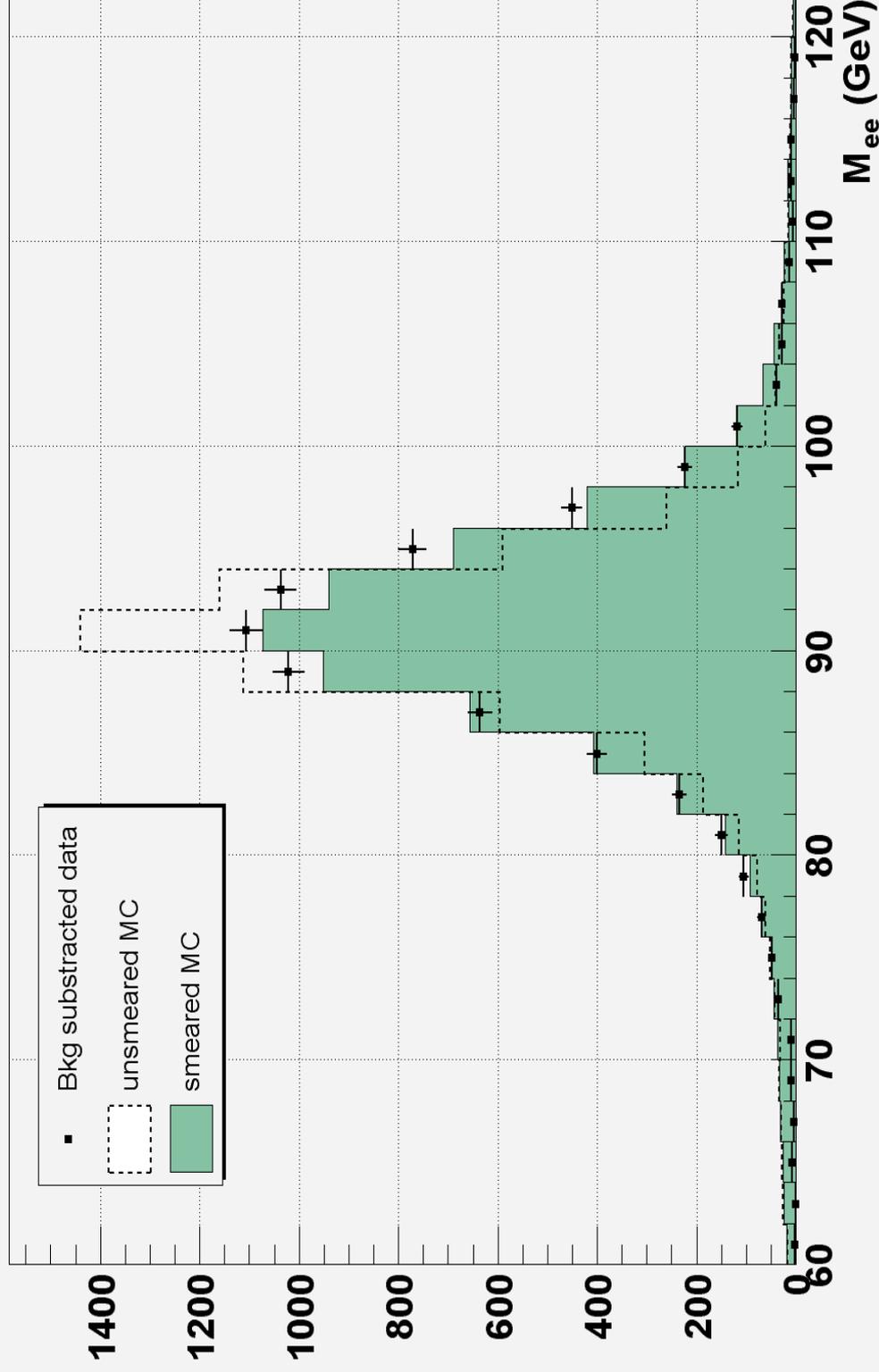
CAL



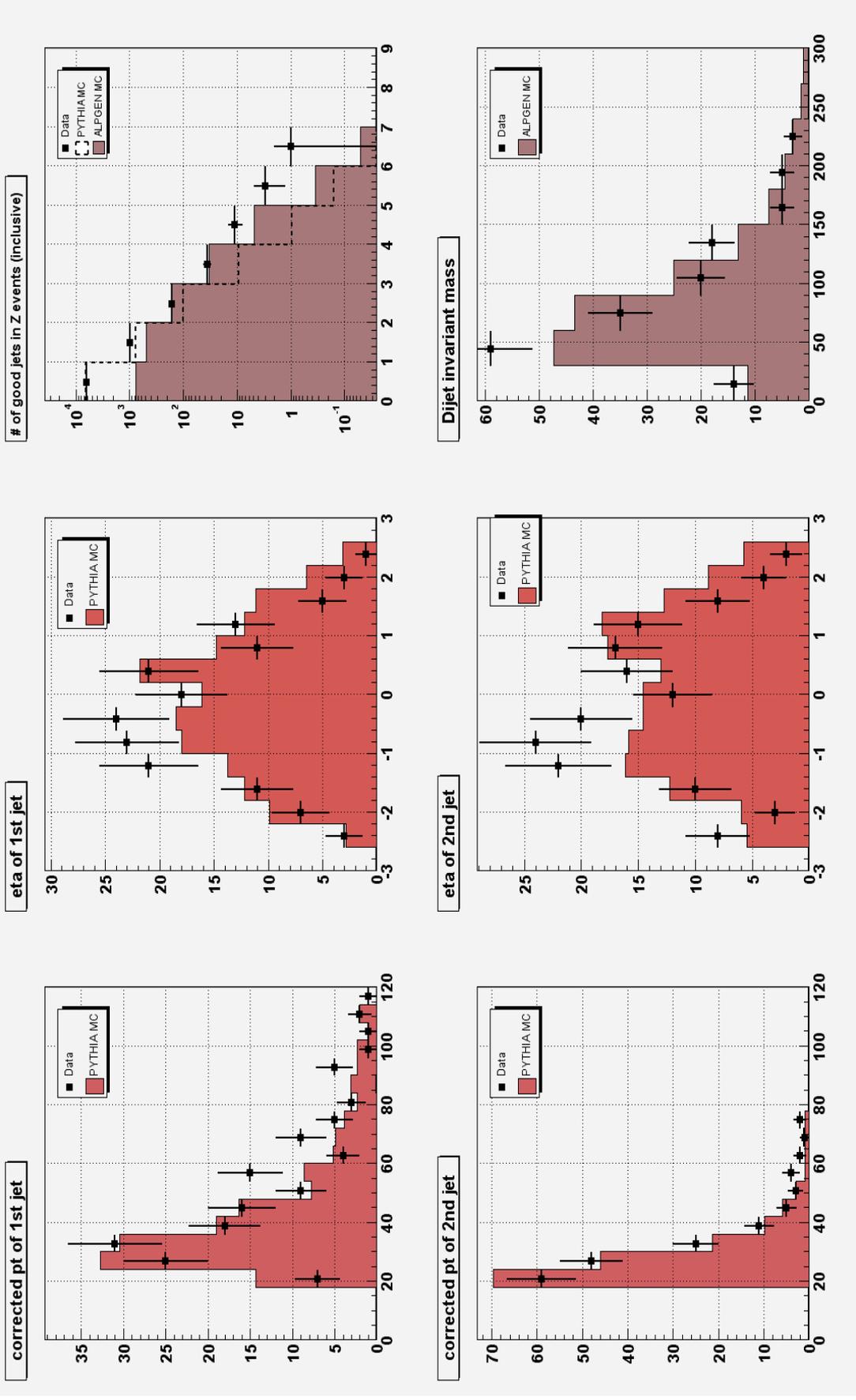
All electrons passing EMF, Iso, HMX, pT cuts - no fiducial cuts
- rejecting bad events (Jet/MET, CAL, SMT, CFT, lumi LBNS)

Z peak - data vs MC

dilepton invariant mass (1 track)

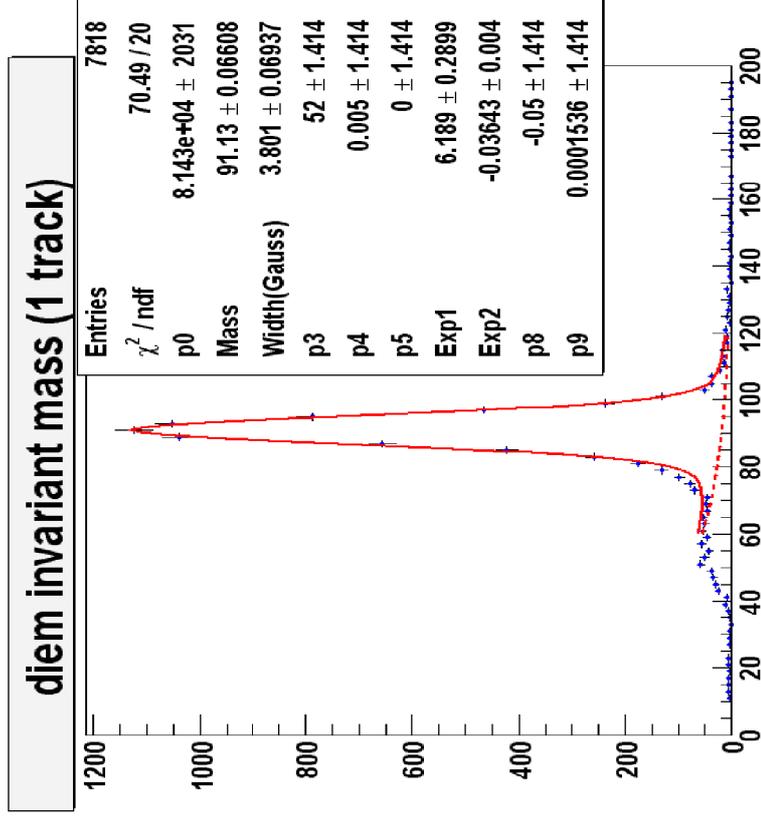


Jets in Z candidate events (p14 data vs PYTHIA/ALPGEN MC)



QCD background

- Using **smear**ed MC to determine fraction of DY in Z/Gamma* -> ee: **1.99%**
- Fitting exponential and convolution of Gaussian & BW to diem invariant mass plot to separate pure Z->ee from DY+QCD

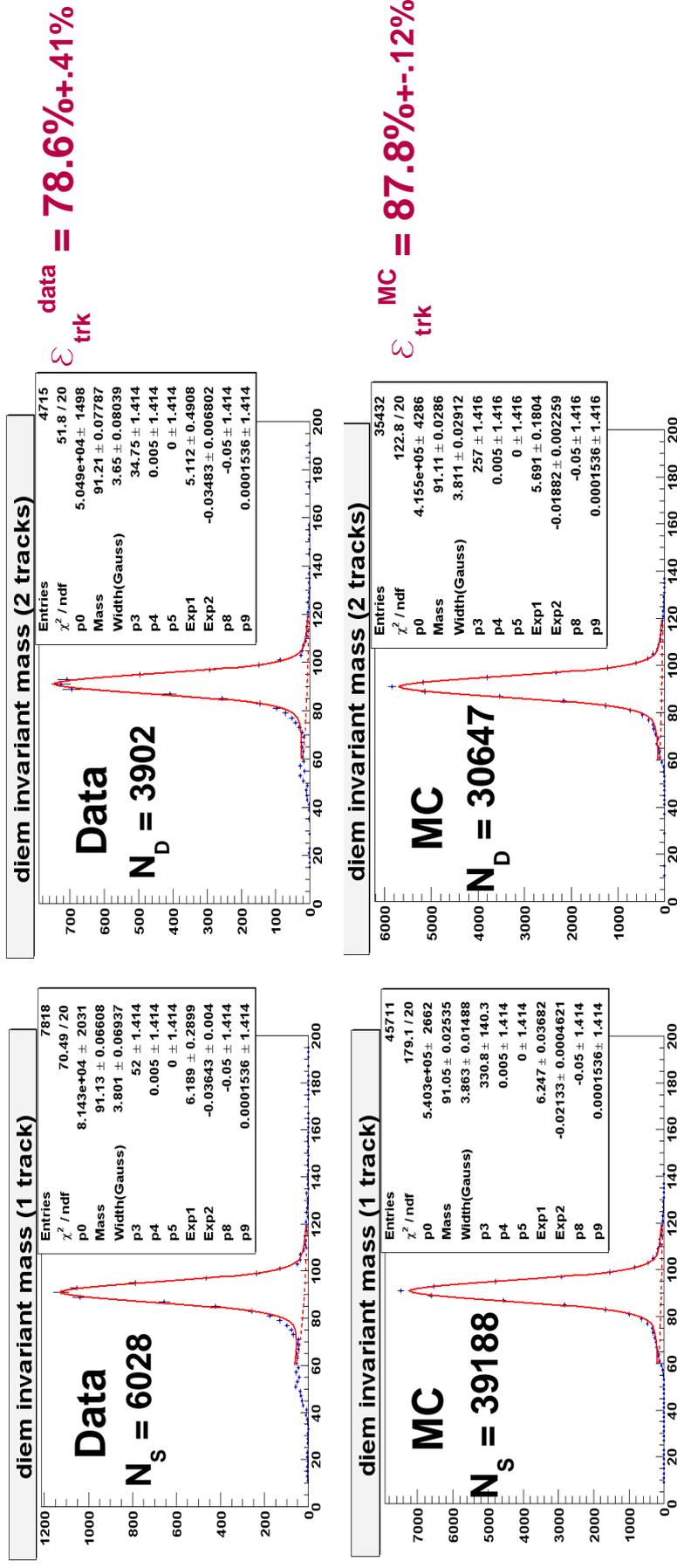


Total # of events (80-100GeV) = **6216**
 # from QCD and DY (80-100GeV)= 188

=> **Signal** = Z + DY = **6150 +-81**
Background = QCD = **66 +-18**

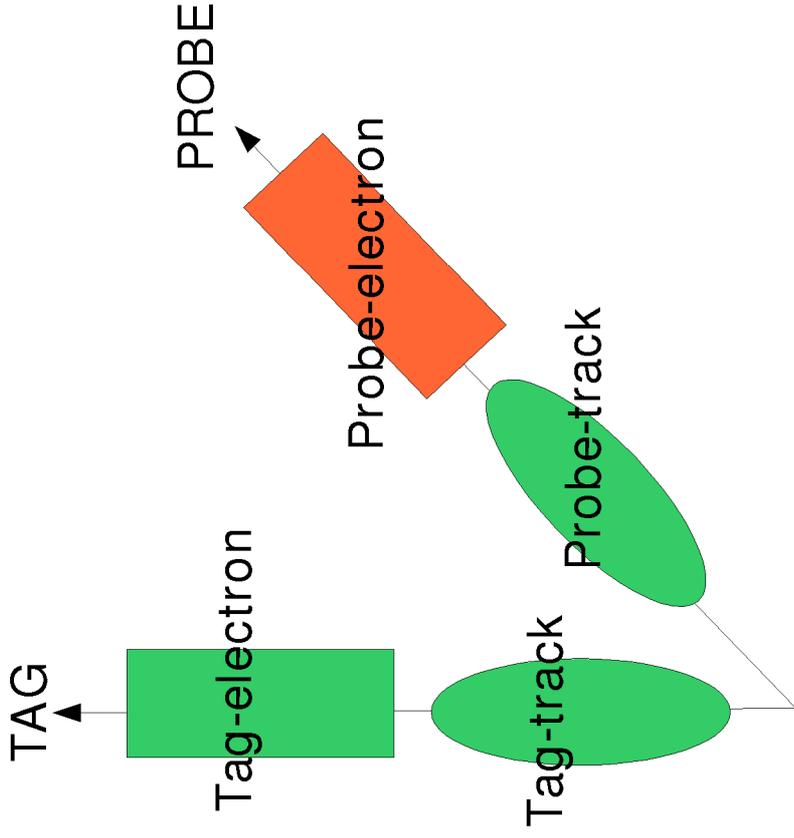
Track efficiency in data and MC

- N_S = # of events with 2 trk matches
- N_D = # of events with at least 1 trk match
- Efficiency = $2N_D/N_D + N_S$
- Fit: Gaussian+BW for signal and exponential(data)/linear function (MC) for background



EM efficiency in data and MC

Tag and probe method:



Tag electron:

EMF>.9, Iso<.15, **HMx7<12.**,
pT>20GeV, |det_eta|<1.1

Tag/Probe tracks:

20GeV<pT<80GeV, |eta|<1.1,
Chi^2<8., DCA wrt r-phi <.3,
DCA wrt best vtx<4.cm,
del_phi<2.

Invariant tag-electron probe-track
mass m: 70GeV < m < 110GeV

Probe electron:

EMF>.9, Iso<.15, **HMx7<12.**

$$\epsilon_{EM}^{data} = \epsilon_{EMreco}^{data} \times \epsilon_{EMF,Iso}^{data} \times \epsilon_{HMx7}^{data} = 95.5\% \pm 0.4\% \times 99.2\% \pm 0.6\% \times 93.3\% \pm 0.7\% = \mathbf{88.7\% \pm 0.6\%}$$

$$\epsilon_{EM}^{MC} = \epsilon_{EMreco}^{MC} \times \epsilon_{EMF,Iso}^{MC} \times \epsilon_{HMx7}^{MC} = 96.6\% \pm 0.1\% \times 99.3\% \pm 0.1\% \times 96.6\% \pm 0.2\% = \mathbf{93.1\% \pm 0.2\%}$$



Z(ee) + X Cross Section

$$XSection \cdot BR = \frac{N - B}{Lumi \cdot Trigger \cdot Accept \cdot Trk \cdot EM}$$

	Value	Uncertainty
N-B	6150	81
Lumi	170.01pb-1	11.05pb-1
$A = N_{pass}^{MC} / N_{total}$	18.4%	0.1%
ϵ_{EMreco}^{data}	96.6%	0.1%
ϵ_{trk}^{data}	78.6%	0.4%
ϵ_{EM}^{data}	88.7%	0.6%

$Accept = \frac{N_{pass}}{N_{total}} * \frac{1}{\epsilon_{EMreco}^{MC}}$
 $Trk = 2 * \epsilon_{trk}^{data} - \epsilon_{trk}^{data2}$
 $EM = \epsilon_{EM}^{data2}$

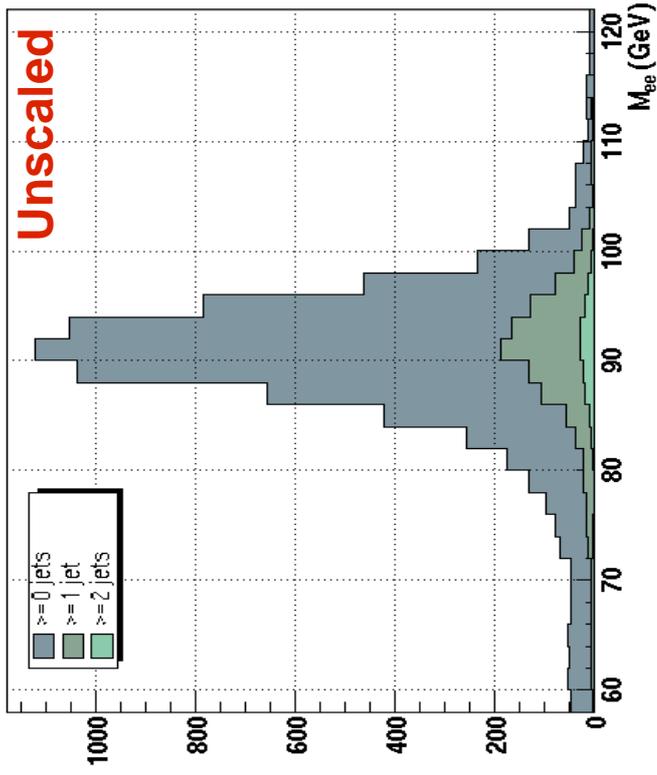
Signal Efficiency = Accept x Trk x EM = 14.1%

$\sigma \times BR$ **253.0pb** **4.5pb**

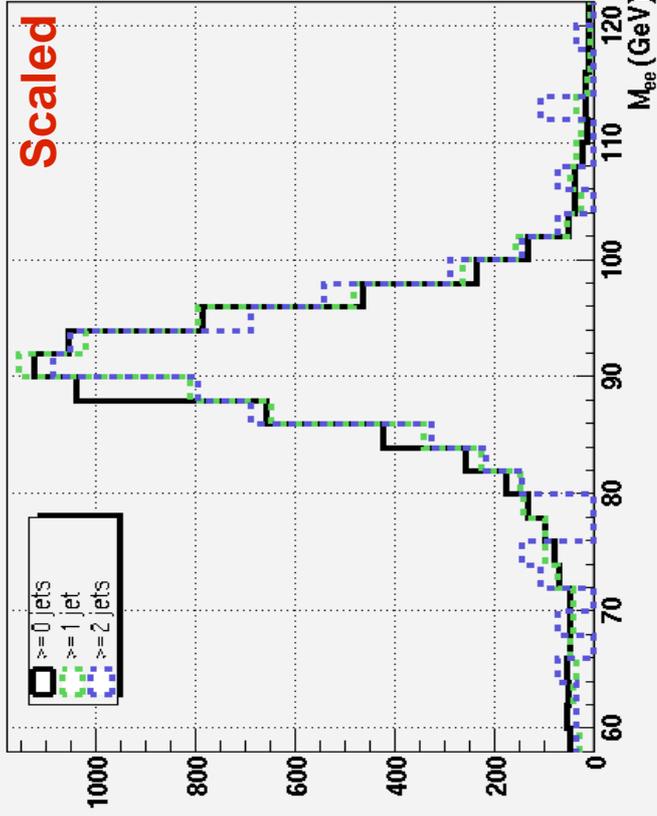


A first look at $Z(ee)+n\text{Jets}$ ($n \geq 1, 2$)

diem invariant mass (1 track)

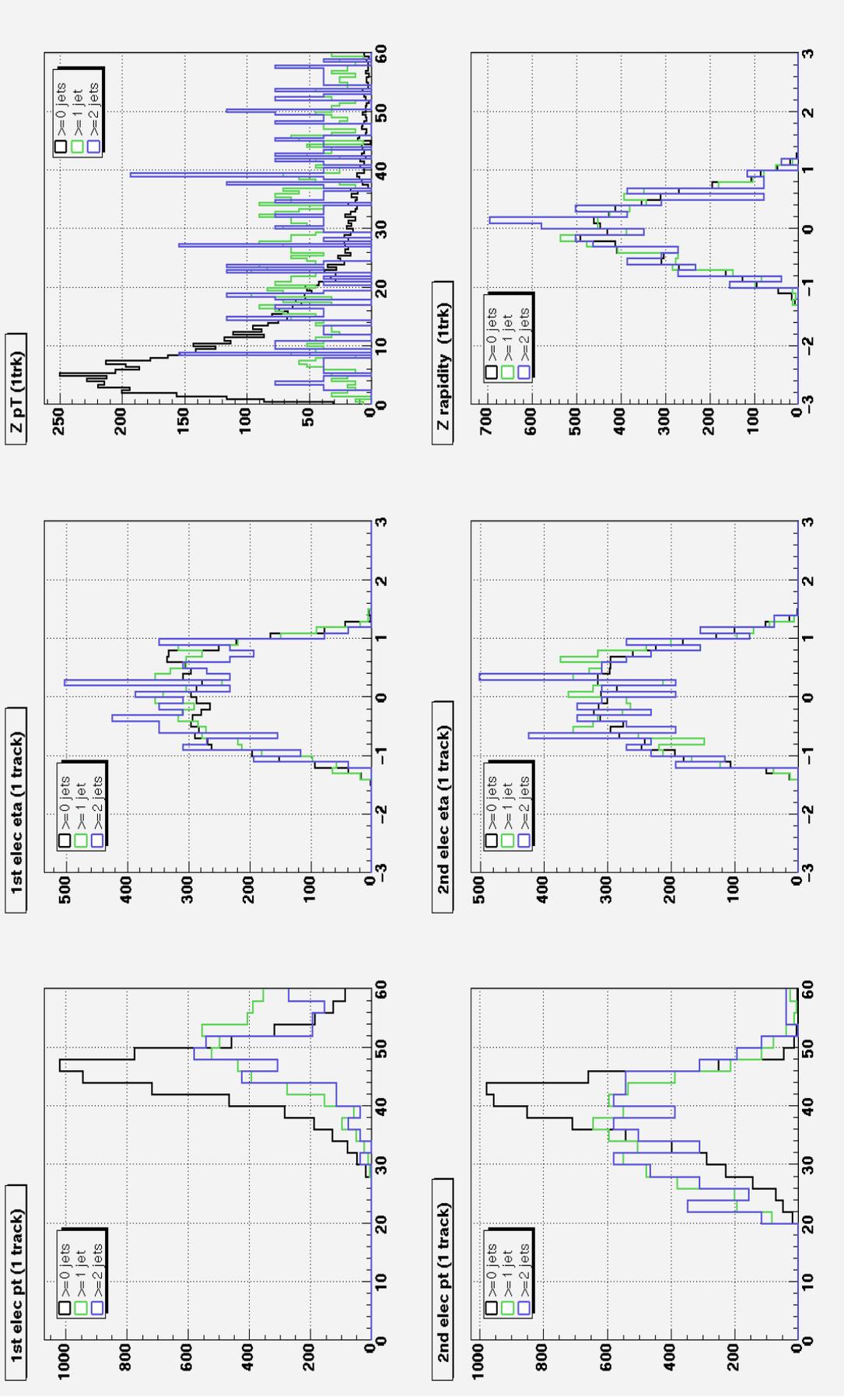


diem invariant mass (1 track)



	$n \geq 0$	$n \geq 1$	$n \geq 2$
# of Z candidates	6,216	964	161
Mean	(91.13 \pm 0.7)GeV	(91.50 \pm .17)GeV	(91.64 \pm .40)GeV
Width	(3.80 \pm .07)GeV	(3.78 \pm .09)GeV	(3.70 \pm .36)GeV

Electrons in Z candidate events



Summary

Jet multiplicity	$n \geq 0$	$n \geq 1$	$n \geq 2$	$n \geq 3$
N-B	6150$_{-81}$?	?	?
Lumi	170.01 pb$_{-11.05}$	170.01 pb$_{-11.05}$	170.01 pb$_{-11.05}$?
Acc	18.4%$_{-0.1}$?	?	?
ϵ_{EMreco}^{MC}	96.6%$_{-0.1}$?	?	?
ϵ_{trk}^{data}	78.6%$_{-0.4}$	75.3%$_{-1.1}$	76.5%$_{-2.7}$?
ϵ_{EM}^{data}	88.7%$_{-0.6}$?	?	?
$\epsilon_{trigger}$?	?	?	?
Xsection x BR	253.0 pb$_{-4.5}$ pb			

